CLAIMS

What is claimed is:

1. A control system that generates one of a normal mode and a hot mode signal to control operation of a transmission, comprising:

a calculator calculates a predicted temperature of a torque converter;

a comparator that compares said predicted temperature to a threshold temperature; and

a timer that generates one of said normal mode and said hot mode signals based on said predicted temperature and said threshold temperature.

2. The control system of claim 1 wherein said hot mode signal is generated when said predicted temperature is greater than said threshold temperature for a threshold time.

3. The control system of claim 1 wherein said normal mode signal is generated when said predicted temperature is lower than said threshold temperature for a threshold time.

4. The control system of claim 1 further comprising a controller that operates said transmission to reduce slipping of said torque converter based on said hot mode signal.

5. The control system of claim 1 wherein said calculator calculates said predicted temperature based on work loss through said torque converter, flow rate through said torque converter, a heat transfer coefficient for air and a heat transfer coefficient for oil flowing through said torque converter.

6. The control system of claim 5 wherein said calculator calculates said work loss based on a speed ratio, an input torque into said torque converter and an output torque from said torque converter.

7. The control system of claim 6 wherein said calculator calculates said speed ratio based on an engine speed signal and a transmission speed signal.

8. The control system of claim 6 wherein said calculator calculates said input torque based on an engine speed signal and a K-factor.

9. The control system of claim 8 wherein said K-factor is determined from a look-up table based on said speed ratio.

10. The control system of claim 6 wherein said output torque is based on said input torque and a torque ratio.

11. The control system of claim 10 wherein said torque ratio is determined from a look-up table based on said speed ratio.

12. The control system of claim 5 wherein said calculator determines said flow rate from a look-up table based on a line pressure signal and an engine speed signal.

13. The control system of claim 5 wherein said calculator calculates said heat transfer coefficient of air based on a speed ratio and a locked state of a torque converter clutch.

14. A control system that operates a transmission in one of a normal mode and a hot mode, comprising:

a torque converter that transfers drive torque from an engine to said transmission; and

a controller that calculates a predicted temperature of said torque converter based on a thermal model of said torque converter, that compares said predicted temperature to a threshold temperature and that operates said transmission in one of said normal mode and said hot mode based on said predicted temperature and said threshold temperature.

15. The control system of claim 14 wherein said transmission is operated in said hot mode when said predicted temperature is greater than said threshold temperature for a threshold time.

16. The control system of claim 14 wherein said controller operates said transmission from said hot mode to said normal mode when said predicted temperature is lower than said threshold temperature for a threshold time.

17. The control system of claim 14 wherein when in said hot mode said controller operates said transmission to reduce slipping of said torque converter.

18. The control system of claim 14 wherein said thermal model is based on work loss through said torque converter, flow rate through said torque converter, a heat transfer coefficient for air and a heat transfer coefficient for oil flowing through said torque converter.

19. The control system of claim 18 further comprising calculating said work loss based on a speed ratio, an input torque into said torque converter and an output torque from said torque converter.

20. The control system of claim 19 further comprising:

an engine speed sensor that generates an engine speed signal;

a transmission speed sensor that generates a transmission speed signal; and

wherein said speed ratio is calculated based on a said engine speed signal and said transmission speed signal.

21. The control system of claim 19 further comprising an engine speed sensor that generates an engine speed signal, wherein said input torque is based on said engine speed signal and a K-factor.

22. The control system of claim 21 wherein said K-factor is determined from a look-up table based on said speed ratio.

23. The control system of claim 19 wherein said output torque is based on said input torque and a torque ratio.

24. The control system of claim 23 wherein said torque ratio is determined from a look-up table based on said speed ratio.

25. The control system of claim 18 further comprising:

a pressure sensor that generates a line pressure signal;

an engine speed sensor that generates an engine speed signal; and

wherein said flow rate is determined from a look-up table based on said line pressure signal and said engine speed signal.

26. The control system of claim 18 further comprising a torque converter clutch that is operable in a locked mode and an unlocked mode, wherein said heat transfer coefficient of air is determined based on a speed ratio and a mode of said torque converter clutch.

27. A method of cooling a torque converter of a transmission that is operable in a first mode and a second mode, comprising:

calculating a predicted temperature of said torque converter based on a thermal model of said torque converter while said transmission is operating in said first mode;

comparing said predicted temperature to a threshold temperature; and

operating said transmission in one of said first mode and said second mode based on said predicted temperature and said threshold temperature.

28. The method of claim 27 wherein said transmission is operated in said second mode when said predicted temperature is greater than said threshold temperature for a threshold time.

29. The method of claim 27 further comprising switching operation of said transmission from said second mode to said first mode when said predicted temperature is lower than said threshold temperature for a threshold time.

30. The method of claim 27 wherein when in said second mode said transmission is operated to reduce slipping of said torque converter.

31. The method of claim 27 wherein said thermal model is based on work loss through said torque converter, flow rate through said torque converter, a heat transfer coefficient for air and a heat transfer coefficient for oil flowing through said torque converter.

32. The method of claim 31 further comprising calculating said work loss based on a speed ratio, an input torque into said torque converter and an output torque from said torque converter.

33. The method of claim 32 further comprising calculating said speed ratio based on a pump speed and a turbine speed.

34. The method of claim 33 further comprising calculating said input torque based on a pump speed and a K-factor.

35. The method of claim 34 wherein said K-factor is determined from a look-up table based on said speed ratio.

36. The method of claim 32 further comprising calculating said output torque based on said input torque and a torque ratio.

37. The method of claim 36 wherein said torque ratio is determined from a look-up table based on said speed ratio.

38. The method of claim 31 wherein said flow rate is determined from a look-up table based on transmission line pressure and engine speed.

39. The method of claim 31 wherein said heat transfer coefficient of air is determined based on a speed ratio and a state of a torque converter clutch.

40. A vehicle operable in one of a normal mode and a hot mode, comprising:

a transmission;

a torque converter that transfers drive torque from an engine to said transmission; and

a controller that calculates a predicted temperature of said torque converter based on a thermal model of said torque converter, that compares said predicted temperature to a threshold temperature and that operates said vehicle in said hot mode if said predicted temperature is greater than said threshold temperature for a first threshold time period.

41. The vehicle of claim 40 wherein said controller switches operation of said vehicle from said hot mode to said normal mode if said predicted temperature is less than said threshold temperature a second threshold time period.

42. The vehicle of claim 40 wherein when in said hot mode said controller operates said transmission to reduce slipping of said torque converter.

43. The vehicle of claim 40 wherein said thermal model is based on work loss through said torque converter, flow rate through said torque converter, a heat transfer coefficient for air and a heat transfer coefficient for oil flowing through said torque converter.

44. The vehicle of claim 43 further comprising calculating said work loss based on a speed ratio, an input torque into said torque converter and an output torque from said torque converter.

45. The vehicle of claim 44 further comprising:

an engine speed sensor that generates an engine speed signal;

a transmission speed sensor that generates a transmission speed signal; and

wherein said speed ratio is calculated based on a said engine speed signal and said transmission speed signal.

46. The vehicle of claim 44 further comprising an engine speed sensor that generates an engine speed signal, wherein said input torque is based on said engine speed signal and a K-factor.

47. The vehicle of claim 46 wherein said K-factor is determined from a look-up table based on said speed ratio.

48. The vehicle of claim 44 wherein said output torque is based on said input torque and a torque ratio.

49. The vehicle of claim 48 wherein said torque ratio is determined from a look-up table based on said speed ratio.

50. The vehicle of claim 43 further comprising:

a pressure sensor that generates a line pressure signal;

an engine speed sensor that generates an engine speed signal; and

wherein said flow rate is determined from a look-up table based on said line pressure signal and said engine speed signal.

51. The vehicle of claim 43 further comprising a torque converter clutch that is operable in a locked mode and an unlocked mode, wherein said heat transfer coefficient of air is determined based on a speed ratio and a mode of said torque converter clutch.